Patent Claims

1. A method for the determination of the blood volume during an extracorporeal blood treatment with a blood treatment apparatus in an extracorporeal blood circuit, which has an arterial branch of a blood line leading to the blood treatment apparatus and a venous branch of the blood line leading away from the blood treatment apparatus, characterised in that pulse waves are generated in the extracorporeal blood circuit, whereby the propagation rate or transit time of the pulse waves being propagating in the extracorporeal circuit is measured and the blood volume is determined from the measured propagation rate or transit time of the pulse waves.

2. The method according to claim 1,

    <u>characterised in that</u> the propagation rate or transit time of the pulse waves generated by a blood pump in the extracorporeal circuit is measured.

3. The method according to claim 1 or 2,

    <u>characterised in that</u> the pulse waves generated by a blood pump are detected by a pressure sensor arranged in the extracorporeal circuit.

4. The method according to claim 3,

    <u>characterised in that</u> the blood pump is arranged in the arterial branch of the blood line upstream of the blood treatment apparatus and the pressure sensor for detecting the pulse waves is arranged downstream of the blood treatment apparatus in the venous branch of the blood line.

5. The method according to claim 4,

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characterised in that the pulse waves generated by the blood pump are detected by a second pressure sensor, which is arranged upstream of the blood treatment apparatus in the arterial branch of the blood line.

6.   The method according to any one of claims 1 to 5,

characterised in that the relative blood volume RBV(t) is determined from the ratio of the transit times or propagation rates of the pulse waves at two different times t, t_0 of the blood treatment.

7.   The method according to claim 6,

characterised in that the relative blood volume RBV(t) is calculated from the temporal change in the transit time of the pulse waves according to the following equation:

$$RBV(t) = \frac{1 - \dfrac{\rho_w}{\rho(t_0)}}{\left(\dfrac{PTT(t)}{PTT(t_0)}\right)^2 - \dfrac{\rho_w}{\rho(t_0)}}$$

whereby

PTT(t) and PTT(t_0) is the transit time of the pulse waves over a segment of the extracorporeal blood circuit with a predetermined length L at time t and to and ρ_w is the mass density of water and p(t_0) the mass density of the blood at the start of the blood treatment.

8.   A device for the determination of the blood volume during an extracorporeal blood treatment in an extracorporeal blood circuit (I), which has an arterial branch (5) of a blood line (5, 7) leading to a blood treatment apparatus (1) and a venous branch (7) of the blood line (5, 7) leading away from the blood treatment apparatus, with

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means (26, 27, 30) for measuring the propagation rate or transit time of pulse waves being propagated in the extracorporeal circuit,

characterised by

means (6) for the generation of pulse waves in the extracorporeal blood circuit (I), and

means (30) for the determination of the blood volume, which are designed in such a way that the blood volume can be determined from the measured transit time or propagation rate of the pulse waves.

9. The device according to claim 8,

characterised in that a blood pump (6) is arranged in the extracorporeal circuit (I), whereby the means (26, 27, 30) for measuring the transit time or propagation rate of the pulse waves are designed in such a way that the propagation rate or transit time of the pulse waves generated by the blood pump (6) in the extracorporeal circuit is measured.

10. The device according to claim 8 or 9,

characterised in that a pressure sensor (27) for detecting the pulse waves generated by the blood pump (6) is arranged in the extracorporeal circuit (I).

11. The device according to claim 10,

characterised in that the blood pump (6) is arranged in the arterial branch (5) of the blood line (5, 7) upstream of the blood treatment apparatus (1) and the pressure sensor (27) for detecting the pulse waves is arranged downstream of the blood treatment apparatus in the venous branch (7) of the blood line (5, 7).

12. The device according to claim 11,

characterised in that a second pressure sensor (26) for detecting the pulse waves is arranged upstream of the blood treatment apparatus (1) in the arterial branch of the blood lines (5, 7).

13. The device according to any one of claims 8 to 12,

characterised in that the means (30) for determining the relative blood volume are designed in such a way that the relative blood volume RBV(t) can be determined from the ratio of the transit times or propagation rates of the pulse waves at two different times t, t_0 of the blood treatment.

14. The device according to claim 13,

characterised in that the means (30) for determining the relative blood volume are designed in such a way that the relative blood volume RBV(t) is calculated from the temporal change in the transit times of the pulse waves according to the following equation,

$$RBV(t) = \frac{1 - \dfrac{\rho_w}{\rho(t_0)}}{\left(\dfrac{PTT(t)}{PTT(t_0)}\right)^2 - \dfrac{\rho_w}{\rho(t_0)}}$$

whereby

PTT(t) and PTT(t_0) is the transit time of the pulse waves over a segment of the extracorporeal blood circuit with a predetermined length L at times t and to and ρ_w is the mass density of water and $\rho(t_0)$ the mass density of the blood at the start of the blood treatment.

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